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OBSERVATIONS ON TWO OVERWINTERING CLUSTERS OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) IN THE SYDNEY AREA DURING 1978

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Abstract

Two overwintering cluster sites of *Danaus plexippus* (L.) at Bayview and Wallacia in the Sydney area, are recorded for the first time. Observations made during 1978 at these sites are presented. Possible environmental factors influencing clustering and breeding activity during winter are discussed.

Introduction

The occurrence of overwintering clusters of *Danaus plexippus* (L.) (wanderer butterfly) was first recorded in Australia in 1965, at sites to the south-west of Sydney, in the Razorback area and near Theresa Park (Smithers, 1965). Further cluster sites were also known at Menangle Park and Otford. Prior to 1965 clustering activity of *D. plexippus* had been observed in the Hunter Valley and Adelaide areas, although no detailed studies were made (Rayment, 1942; Dowling and Haines, 1963).

During 1978, as part of a current study on the breeding status of *D. plexippus* during winter in the Sydney area, regular observations were made at two newly discovered overwintering sites at Bayview and Wallacia. These observations are presented and discussed with respect to their significance to the reproductive ecology of *D. plexippus* during winter in the Sydney area.

The overwintering site at Wallacia, 41 km from Sydney in the central west of the Sydney basin is similar in configuration to the previously recorded sites at Razorback and near Theresa Park (Smithers, 1965). It consists of a narrow, lightly wooded gully situated in moderately hilly country used mainly for stock grazing.

The site at Bayview, a northern coastal suburb 20 km from Sydney, occupies a very small area at the top of a small hill within a residential district. The site is lightly wooded waste land with abandoned vehicles and general refuse littering the area.

Observations of clustering activity at both sites commenced in mid May, and continued throughout the period of clustering. Observations were made bimonthly at both sites although weekly visits were made to the Wallacia site during the latter half of the clustering period. Data compiled during each visit included weather data, counts of the cluster population, estimations of sex ratios, and observations of behaviour. In addition samples of females were taken for dissection. Population counts involved counting individual clusters on branches and bushes when the insects were least active, i.e. early morning or late afternoon. As the clusters invariably reformed on the same branches throughout the period of clustering, some uniformity was preserved in the assessment of numbers at each visit. Sex ratios were estimated by netting small clusters of 50 to 100 individuals when possible, and treating these specimens as a representative sample. General observations were made at each visit of flight activity, courtship behaviour, and evidence of mortality. The small samples of females taken at each visit were dissected to gain an indication of the reproductive condition of the cluster. Results from these dissections are considered fairly representative of the cluster as a whole. Any ovarian development would probably occur more or less simultaneously throughout the cluster population, given that environmental influences would be basically uniform within the restricted area of a clustering site. Larger samples were not considered because of possible adverse effects upon the future reproductive potential of the cluster populations.

Results

In 1978 clustering activity of *D. plexippus* commenced at both sites in mid May. On the 28th May 500 specimens were counted at Bayview and 1000 specimens at Wallacia, in the main clusters at each site. By mid June the Bayview population had increased to 800 specimens, while the Wallacia population remained at 1000 specimens. By the end of June populations at both sites had declined, to 400 specimens at Bayview, and 800 specimens at Wallacia. Populations diminished further during the first week of July, and the clusters dispersed completely at both sites between the 9th and 18th of July.

Throughout the period of clustering the Wallacia population maintained an approximately equal ratio of males to females. However, from an initially equal sex ratio, the Bayview population became predominantly male from mid June onwards. There was no immediately apparent explanation for this sudden sex ratio imbalance. There was no evidence of heavy female mortality at this time, indeed cluster mortality appeared to be minimal. As cluster numbers at Bayview increased by nearly 50% at this time it is possible that the new influx was predominantly male creating the resulting imbalance. Alternatively a substantial proportion of the females present at the end of May, may have left the cluster during early June.

The total cluster populations at Wallacia and Bayview in 1978 although impressive, were not as vast as the cluster populations seen in the Razorback area during the early sixties (Smithers, 1965). The Razorback clustering site mentioned by Smithers (Smithers, 1965; 1972) was also kept under observation during the winter of 1978. The largest total population seen at that site was

500 specimens in mid June. The date of cluster formation was not recorded, but dispersal occurred significantly later than at the Bayview and Wallacia sites. Small numbers were still present at the Razorback site on 12th August.

Behaviour of the cluster populations at Bayview and Wallacia varied according to prevailing weather conditions. On sunny days a period of flight activity usually occurred from 11 am to 3 pm E.S.T. By mid afternoon clusters would begin reforming. During periods of dull overcast weather the clusters would remain inactive. The availability of suitable flowers for nourishment was very limited at both sites, but particularly at Wallacia. It seems likely that cluster individuals contain enough body fat reserves at commencement of clustering to sustain them through the two months or so of reproductive diapause. It is possible that some benefit is gained from "drinking" beads of moisture or from damp ground, although this was not observed. Mating was observed at both sites throughout the period of clustering. It was common to observe courtship flights during periods of flight activity.

Mortality of the cluster populations at both sites, as evidenced by wings on the ground, increased progressively through the clustering period. Birds were never observed to prey on the clusters or on individuals in flight during the visits. However, beak marks on some of the wings found suggests that at least some attacks were made. Adverse weather conditions with above average rainfall and frequent strong winds during late June probably accounted for much of the observed increased mortality at this time.

Dissections of samples of females taken from both sites soon after clustering commenced revealed no evidence of ovarian development. Ovaries were small and showed no trace of yolk deposition. They were comparable in size and weight (1-2 mg) to the inactive ovaries of newly emerged adults. Oogenesis was not detected in any of the samples taken during June. Some sampled females did show evidence of oosorption as indicated by immature oocytes in various stages of fragmentation, and by the presence of pigmented breakdown products at the base of the ovarioles. These were possibly females that had previously undergone at least some ovarian development before environmental conditions initiated a reproductive diapause. Actively breeding adults under summer conditions never show oosorption characteristics. Two females taken from the Wallacia cluster on 8th July contained ovaries showing extensive yolk deposition along the ovarioles. Two females taken from the Bayview site on 9th July also exhibited extensive yolk deposition, together with the formation of some immature oocytes. On the 15th July two females taken from the Wallacia site showed extensive yolk deposition and large numbers of immature oocytes. By the 18th July the Wallacia cluster had dispersed and the Bayview cluster was not in evidence on 22nd July, although it probably dispersed a few days earlier. From this limited sampling of females from both cluster sites it suggests that significant ovarian development preceded cluster dispersal, although dispersing females were probably not gravid. However, mature oocytes and reproductive activity would probably be attained soon after dispersal. Similar sampling of females at the Razorback cluster site was also undertaken.

Two females taken on 12th August were gravid with 7 and 14 mature oocytes respectively. This was prior to the complete dispersal of the cluster. The apparently gravid condition of dispersing females from the Razorback cluster as opposed to the non gravid condition of dispersing females from the Bayview and Wallacia sites, may possibly be explained by differences in geographical location and duration of clustering period.

Discussion

The mechanisms and significance of overwinter clustering of *D. plexippus* in Australia are not as well understood as those of the same species in the United States. In that country vast migrations ranging over thousands of miles precede clustering activity. Two main overwintering areas are known, one in Mexico and the other in California. From extensive tagging programmes it appears that the western *D. plexippus* population of North America overwinters in California, and the Eastern population in Mexico (Urquhart, 1976; 1977). Although population movements do occur in Australia, they appear to be mainly related to an annual extension and contraction of range (Smithers, 1977). Only one obvious unidirectional flight has been reported (Smithers, 1965). From earlier studies on the breeding ecology of *D. plexippus* in the Razorback area (Smithers, 1972), it appeared that cluster populations were not derived from individuals in the cluster area. Furthermore cluster individuals did not appear to breed in the cluster area after dispersal. It would therefore seem that some degree of migration is associated with clustering activity in the Sydney area.

At both the Bayview and Wallacia sites, breeding populations of *D. plexippus* existed alongside the reproductively inactive cluster populations during the winter of 1978. Eggs and larvae were found through the winter on healthy plants of *Gomphocarpus fruticosus* (milkweed), the major food plant of *D. plexippus* in the Sydney area. In addition, gravid females were captured at both locations flying over the breeding areas. Reproductive activity in *D. plexippus* is under environmental control, primarily temperature and photoperiod. Lowering of temperature and shortening of photoperiod initiate reproductive diapause and associated migratory and clustering behaviour (Barker and Herman, 1976). The situation of breeding and non breeding populations could only arise if post eclosion environmental influences on each population differed. If cluster populations are derived from other areas, then it is possible that a different set of environmental influences could operate during the critical post eclosion period, than those found in the breeding areas, adjacent to the cluster site. A further possibility is the existence of differing micro and meso climates at different breeding areas, influencing the extent of reproductive activity in populations of newly emerged specimens. The timing of the emergence of new generations, with respect to prevailing weather conditions encountered, could also be of significance. The fact that breeding and cluster populations can exist in the same area without the cluster population becoming reproductively active, suggests some difference in environmental conditions between the cluster and breeding sites. Alternatively there may be some difference in response to environmental conditions by newly emerged and diapause females. The over-

wintering sites known in the Sydney area are invariably shady locations, and all but the Bayview site are situated in gullies or narrow valleys. A gully situation offers very limited insolation during the winter months, with direct sunlight penetrating for only a short period daily. The winter breeding areas at Bayview and Wallacia in 1978 were situations receiving maximum influence from the sun. The breeding site at Wallacia was situated on a hillside facing north and received sunshine from sunrise to sunset during the winter. The cluster area barely two hundred metres distant in the shadow of the breeding site hillside, received sunshine for a much shorter daily period. Some preliminary work on the influence of insolation upon ovarian development in *D. plexippus*, has indicated that this factor may be of great significance to breeding activity during winter in the Sydney area. Batches of newly emerged females kept in sunny and shady situations in a single location, under winter conditions, demonstrate significant differences in ovarian development. The specimens receiving daily sunshine produced mature oocytes after one week, whilst the specimens receiving no sunlight showed no ovarian development after the same period. Although newly emerged females during winter are unlikely to remain in sunlight for the maximum period available, they will experience significantly more than individuals at a cluster site. The environmental control of the reproductive ecology of *D. plexippus* in the Sydney area during winter is currently being investigated. It is hoped this will provide a greater understanding of winter breeding and clustering activity, and of the factors involved.

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